

APPENDIX I

PRELIMINARY RISK ASSESSMENT

Memorandum

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To: Preliminary Risk Assessment (PRA) File

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RE: Impact Area South of the Prisoner of War Training Facility, Former Rifle/Machine Gun Ranges (Parcels 100Q and 101Q), Fort McClellan, Calhoun County, Alabama

PRELIMINARY RISK ASSESSMENT FOR SUBJECT SITE: REVISION 1

This memorandum provides a revised Preliminary Risk Assessment (PRA) for the Impact Area South of the Prisoner of War Training Facility, Former Rifle/Machine Gun Ranges (Parcels 100Q and 101Q), herein called the Impact Area. The Impact Area is a rectangular plot (about 195 ft by 716 ft) approximately 3.2 acres in size located in the north-central area of the Main Post of Fort McClellan (FTMC), as shown on Figure 1-1 of the Draft Site Investigation (SI) Report. The Impact Area received rifle and machine gun fire from the firing line at the Former Rifle/Machine Gun Ranges. Expended bullets and bullet fragments were observed on the surface over a substantial portion of the site (Figure 1-2 from the SI report). A linear mound of soil, possibly used as a berm for target placement, runs the full length of the site just to the south of the unimproved road shown on Figure 3-1 from the SI report. Surface and subsurface soil sampling locations, as well as two monitoring well locations, are identified on Figure 3-1 of the SI report. As expected, lead is the primary contaminant of interest. The plots of isopleths of lead concentrations in surface soil (Figure 5-1 from the SI) reveal three discrete areas of contamination. All lead concentrations outside the three areas of contamination are less than the background screening criterion (BSC), calculated as twice the mean of the background data set.

The purpose of the PRA is to evaluate the analytical results from surface soil, subsurface soil and groundwater sampling to support a recommendation for land-use controls (LUC). The Impact Area is slated to be used for industrial purposes, which precludes development for residential purposes.

The PRA is a shortened version of the Streamlined Risk Assessment (SRA) protocol developed as a uniform and economical approach to evaluating hundreds of similar sites at FTMC. It is assumed that the reader is familiar with FTMC and the fundamentals of the SRA. The reader is referred to the Installation-Wide Work Plan (IWWP) (IT, 2002) for more detail. All the comparison and computational operations of the PRA are performed within EXCEL® spreadsheet tables. The results of each step are described below.

The first version of the PRA was prepared in January 2003. The January 2003 version determined that many of the metals in surface soil and total soil were site-related; i.e., their concentrations appeared to exceed background concentrations. Subsequent to that exercise, however, the protocol for FTMC for comparing background and site data sets and for selecting site-related chemicals has changed, making better use of both background and site data, applying more precise statistical comparisons, and employing geochemical analysis to help resolve the site-related question for difficult cases (Shaw, 2003). The refinement in the procedure for selecting site-related chemicals was the main reason for this (first) revision of the PRA.

Media of Interest and Data Selection. Media of interest at the Impact Area include surface soil, subsurface soil and groundwater. Twenty-two surface soil samples from 22 sampling locations were taken from 0 to 1 ft below ground surface (bgs) (Table 5-1 of the SI report). Twenty subsurface soil samples from 19 sampling locations (co-located with surface soil sampling locations) were taken from 2 to 6 ft bgs. The subsurface soil sampling depths were intended to capture the upper bound on subsurface lead contamination in the area impacted by bullets. The soil sampling locations appear to be reasonably distributed across the Impact Area. Two groundwater samples were taken from each of two monitoring wells located at either side of the largest of the three discrete areas of lead contamination. No surface water bodies are associated with the Impact Area.

All surface soil samples were analyzed for metals. In addition, 12 surface soil samples were analyzed for nitroaromatics, and three samples were analyzed for chlorinated herbicides, organochlorine pesticides, organophosphate pesticides, semivolatile organic compounds (SVOC), and volatile organic compounds (VOC). All subsurface soil samples were analyzed for metals. In addition, nine subsurface soil samples were analyzed for nitroaromatics, and three samples were analyzed for chlorinated herbicides, organochlorine pesticides, organophosphate pesticides, SVOCs and VOCs. Two groundwater samples were analyzed for metals, all four groundwater samples were analyzed for nitroaromatics. In addition, three samples were analyzed for organochlorine pesticides and organophosphate pesticides, and one sample was analyzed for chlorinated herbicides, SVOCs and VOCs.

The analytical results are presented in Tables 5-1 through 5-3 of the SI report. All the analytical data were third-party validated. Analytical data that were “B” qualified, indicating that one or more blanks were contaminated, were not used in the PRA. For surface soil, this caused rejection of one detection of methylene chloride, three detections of mercury and selenium, and five detections of sodium. For subsurface soil, this caused rejection of one detection of silver, two detections of calcium, cobalt and methylene chloride, three detections of mercury, four detections of sodium, and eight detections of selenium. Sodium and calcium are considered nutritionally essential elements that are not evaluated in the PRA. The reported concentrations of the other metals and methylene chloride all fell below their respective site-specific screening level (SSSL) for residential soil, indicating that the rejection of these data have no effect on the outcome of the PRA. For groundwater, “B” qualification caused rejection of two detections each of calcium, magnesium, potassium and sodium – all of which are nutritionally essential and are not evaluated in the PRA. “B” qualification also caused rejection of one detection each of arsenic and barium. The reported concentrations, however, were below the BSC, suggesting that

they are within background levels. Therefore, deleting these data had no effect on the outcome of the PRA.

Site-Related Chemical Selection. Site-related chemicals are those presumed to be released by the army during operation of FTMC. Site-related metals were selected by a three-tier process as described in a technical memorandum on background screening (Shaw, 2003). Briefly, the procedure consists of: (Tier 1) comparing the maximum detected concentration (MDC) of each chemical with its BSC, consistent with EPA (2002a) Region IV guidance; (Tier 2) one or more statistical tests, depending on the characteristics of the background and site data sets; and (Tier 3), geochemical evaluation. All organic chemicals were selected as site-related because most of them are not naturally occurring and were presumed to be present as a result of site activities. The results of the site selection process are presented in Tables 1 and 2 for surface soil, Tables 3, 4 and 5 for total soil, and Tables 6, 7 and 8 for groundwater. The results of the statistical tests and geochemical evaluation are provided separately.

Site-related chemicals identified in surface soil include the metals copper and lead, and all the organic chemicals identified in surface soil (Tables 1 and 2). Metals other than lead associated with bullets include antimony, arsenic, nickel and zinc (EPA, 2002b). Antimony was identified in only 1 of 22 samples at a “J” qualified (estimated) concentration (data not shown). The frequency of detection of antimony falls below 5 percent, the level at which EPA (1989) suggests that reported detections may be spurious findings and may be excluded from the risk assessment. The single detection, however, occurred in the sample with the highest concentration of lead, suggesting an association with bullets. Furthermore, antimony was determined to be a site-related chemical in total soil. Considering the overall weight of evidence that the single detection of antimony is most likely related to the presence of bullets, antimony in surface soil is included as a site-related chemical for the purposes of the PRA.

Although arsenic is associated with bullets, the geochemical evaluation demonstrated that it is unlikely to be site-related in surface soil. The geochemical evaluation is generally considered to be highly reliable for identifying site-related levels of arsenic. Therefore, it is concluded that arsenic in surface soil is present at naturally occurring concentrations and arsenic in surface soil is considered no further.

Similarly, geochemical evaluation demonstrated that nickel and zinc are unlikely to be site-related in either surface or total soil. Also, the MDCs of nickel and zinc in soil fall below their respective SSSLs. Therefore, it is concluded that the presence of these metals would have no significant effect on the outcome of the PRA, and these metals in soil are considered no further.

Site-related chemicals identified in total soil include antimony, arsenic, copper and lead, and all the organic chemicals identified in soil (Tables 3, 4 and 5). The MDCs of antimony and lead, 1330 and 22,200 mg/kg, respectively, are extraordinarily high; the concentration of lead is equivalent to 2.2 percent in soil. The MDCs of antimony and lead were identified at sample location IMP-IASPOW-GP03. Highest lead concentrations from the closest surrounding sample locations, IMP-IASPOW-GP04, -GP10 and -GP11, were 17.1, 18.7 and 16.4 mg/kg, respectively). These observations suggest that the sample from location IMP-IASPOW-GP03 was contaminated with a bullet fragment.

The evaluation of nickel and zinc was discussed above.

Site-related chemicals identified in groundwater are limited to a long list of organochlorine pesticides and two nitroaromatic compounds (Tables 6, 7 and 8). Metals associated with bullets were not detected in groundwater.

Receptor Scenario Selection. The proposed reuse for the Impact Area is slated to be industrial. The groundskeeper is selected as the upper bound on exposure to soil for industrial reuse. The groundskeeper is evaluated for exposure to surface soil, assuming that grading or invasive development of the site is not required, with a second evaluation for exposure to total soil assuming that grading or invasive development is required to make the site suitable for the proposed future use. Total soil combines the surface soil and subsurface soil data sets to address the likelihood that site development would involve excavation and grading that would mix surface and subsurface soil. Direct exposure to subsurface soil alone is not plausible. A construction worker is included as a plausible receptor for short-term exposure, because construction activity is likely to be required for future development. Construction would probably include excavation and grading; therefore, the construction worker is assumed to be exposed to total soil rather than only surface soil. An on-site resident is also included, although development for residential use is unlikely, to provide additional perspective. Also, sites that “pass” a residential risk evaluation generally can be released for unrestricted use with no further action. The resident is evaluated for exposure to surface soil, with a second evaluation for exposure to total soil, assuming that development is required to render the site fit for residential use.

Groundwater is evaluated as if it were developed as a source of potable water. It is assumed that the groundskeeper, construction worker and resident would be exposed to groundwater.

Chemical of Potential Concern Selection. Chemicals of potential concern (COPC) are site-related chemicals whose MDCs exceed their SSSLs, and which may contribute significantly to risk. The SSSLs are receptor-, medium-, and chemical-specific risk-based concentrations that capture all the exposure assumptions and toxicity assessment of a full-blown baseline risk assessment. COPCs are selected for both cancer risk and noncancer effects when the data permit.

Chemicals selected as COPCs in surface soil are limited to antimony and lead for residential exposure (Table 1). No chemicals in surface soil are selected as COPCs for groundskeeper exposure (Table 2). Chemicals selected as COPCs in total soil include antimony, arsenic and lead for the resident (Table 3), groundskeeper (Table 5) and construction worker (Table 6). Chemicals selected as COPCs in groundwater include four organochlorine pesticides (aldrin, dieldrin, heptachlor epoxide, beta-BHC) and the nitroaromatic compound 4-amino-2,6-dinitrotoluene (ADNT) for the resident (Table 6). The list of groundwater COPCs is reduced to three organochlorine pesticides (aldrin, dieldrin, heptachlor epoxide) and ADNT for the groundskeeper (Table 7), and further reduced to include only ADNT for the construction worker (Table 8).

Risk Characterization. Risk characterization combines the exposure assumptions and toxicity assessment (incorporated in the SSSLs) with the exposure-point concentration (EPC) to quantify the incremental lifetime cancer risk (ILCR) and noncancer hazard index (HI). ILCR and HI estimates are computed for each COPC in each medium, and are summed across COPCs and media to yield a total ILCR and total HI for each receptor scenario. The PRA differs from an SRA in that the MDC is conservatively adopted as the EPC, at least initially. If refinement is required, the EPC for soil may be recalculated to reflect a conservative estimate of average, i.e., the 95th upper confidence limit on the arithmetic mean (UCL), which is considered a more reasonable and appropriate basis for risk assessment.

EPA (1990) considers ILCR estimates below 1E-6 to be negligible, ILCR estimates from 1E-6 to 1E-4 to fall within a risk management range, and ILCR estimates above 1E-4 to be generally unacceptable. EPA (1989) considers HI values that do not exceed the threshold level of 1 to indicate that the occurrence of adverse noncancer health effects is unlikely.

Summing HI values across chemicals, however, is considered to impart a conservative bias to the assessment, because only those chemicals that share a mechanism of toxicity are likely to interact in an additive manner (EPA, 1989). Since data regarding mechanism of toxicity are generally scarce, target organ or critical effect is often used as a surrogate. In other words, chemicals that act upon the same target organ or that have the same critical effect are considered to act by the same mechanism of toxicity unless sufficient evidence suggests that their mechanisms of toxicity are different. Therefore, when HI values summed across chemicals and media exceed the threshold level of 1, the HI values may be re-summed by target organ to refine the assessment.

Risk estimates may be rounded to one significant figure to reflect the uncertainty about their computation (EPA, 1989, 2002a). For example, a calculated ILCR of 9.50E-7 would be rounded to 1E-6 and interpreted as falling within the risk management range. Similarly, a calculated ILCR of 1.49E-4 would be rounded to 1E-4 and interpreted as falling within, but not exceeding, the risk management range. Also, an HI of 1.49E+0 would be rounded to 1 and interpreted as not exceeding the threshold level of 1. Risk and hazard estimates in this document are presented in scientific notation with two places to the right of the decimal to facilitate checking calculations. Rounding is done only if needed to simplify interpretation.

The foregoing discussion applies to all chemicals other than lead. Lead is treated as a special case because toxicity values are not available with which to estimate ILCR or HI. The SSSLs for lead in soil of 400 mg/kg for the resident and 880 mg/kg for the groundskeeper and construction worker are estimated from standard exposure assumptions and modeled human blood lead levels associated with the potential for adverse effects, primarily inhibited development of the immature central nervous system. The SSSL for the resident is based on the blood lead levels of very young children exposed to soil in a residential setting, because the very young child is the most sensitive member of the human population (EPA, 1998). The SSSL for the groundskeeper and construction worker is based on the blood levels of unborn children carried by working adults exposed to soil (EPA, 1996). Risk characterization for lead, therefore, consists of comparing the concentration in soil with the appropriate SSSLs. Soil lead concentrations that do not exceed the appropriate SSSL pass the evaluation; soil lead concentrations that exceed the

appropriate SSSL fail. Refinement of the lead evaluation consists of comparing the arithmetic mean concentration of lead averaged over the appropriate exposure unit, rather than the MDC, with the SSSL. The arithmetic mean is used instead of the UCL because the blood lead models on which the SSSLs are based contain a statistical module that adjusts for variation in exposure concentrations and exposure behavioral patterns.

Another requirement for lead in soil for sites intended for residential use is that the MDC not exceed the EPA (2003) acute criterion of 6,500 mg/kg. The acute criterion is designed to protect a 2-year-old child from a single pica exposure to lead in soil. No refinement of this evaluation is possible because the acute criterion is designed to protect for a single exposure event at a single location.

The numerical results of the risk characterization are presented below by receptor.

Resident. The resident is evaluated for simultaneous exposure to surface soil and groundwater, and a second time for exposure to total soil and groundwater. The residential scenario is generally considered the most conservative for long-term exposure to a site.

Surface Soil and Groundwater: An ILCR for residential exposure to surface soil was not calculated because no chemicals in surface soil were selected as COPCs based on cancer risk (Table 1). The ILCR of 6.77E-5 for residential exposure to groundwater is due to the presence of low levels of several organochlorine pesticides (Table 6). The total ILCR summed across media of 6.77E-5 falls within the risk management range.

The HI of 1.74E-1 for residential exposure to surface soil is due entirely to a single detection of antimony (Table 1), which appears to be related to the presence of bullets and bullet fragments. The HI of 1.74E+0 for residential exposure to groundwater is due to the presence of low levels of ADNT and several organochlorine pesticides (Table 6). The total HI summed across media of 1.91E+0 exceeds the threshold level of 1. Refinement of the total HI could be performed by segregating the HI estimates for individual target organs. However, this exercise is not performed because the concentration of lead in total soil is sufficiently high to preclude the residential scenario from passing, as discussed below.

Lead was identified as a COPC in surface soil because the MDC of 809 mg/kg exceeds the residential SSSL (Table 1). The arithmetic mean concentration of lead in surface soil of 180 mg/kg (data not shown) does not exceed the SSSL. Also the MDC falls below the EPA (2003) acute criterion of 6,500 mg/kg. Lead in surface soil is unlikely to induce adverse effects in children in a residential setting.

Total Soil and Groundwater: The ILCR of 2.75E-4 for residential exposure to total soil is due entirely to arsenic (Table 3). The ILCR of 6.77E-5 for residential exposure to groundwater (Table 6) was discussed above. The total ILCR summed across media of 3.43E-4 exceeds the risk management range and is considered to be unacceptable. Refinement of the total ILCR could be performed by estimating a more reasonable EPC for arsenic in total soil. However, this exercise is not performed for the reasons described above.

The HI of $4.78\text{E}+1$ for residential exposure to total soil is due to antimony and arsenic (Table 3), which appear to be related to the presence of bullets and bullet fragments. The HI of $1.74\text{E}+0$ for residential exposure to groundwater (Table 6) was described above. The total HI summed across media of $4.95\text{E}+1$ exceeds the threshold level of 1. Refinement of the total HI is not performed for the reasons given above.

Lead was identified as a COPC in total soil because the MDC of 22,200 mg/kg exceeds the residential SSSL (Table 3). The arithmetic mean concentration of lead in total soil of 642 mg/kg (data not shown) also exceeds the SSSL. Furthermore, the MDC exceeds the EPA (2003) acute criterion of 6,500 mg/kg. Lead in total soil may induce adverse effects in children in a residential setting.

Groundskeeper. The groundskeeper is evaluated for simultaneous exposure to surface soil and groundwater, and a second time for exposure to total soil and groundwater. The groundskeeper scenario is generally considered the most conservative for long-term exposure to a site restricted to industrial or commercial use.

Surface Soil and Groundwater: An ILCR for groundskeeper exposure to surface soil was not calculated because no chemicals in surface soil were selected as COPCs based on cancer risk (Table 2). The ILCR of $1.63\text{E}-5$ for groundskeeper exposure to groundwater is due to the presence of low levels of three organochlorine pesticides (Table 7). The total ILCR summed across media of $1.63\text{E}-5$ falls within the risk management range.

An HI for groundskeeper exposure to surface soil was not calculated because no chemicals in surface soil were selected as COPCs based on noncancer effects (Table 2). The HI of $1.81\text{E}-1$ for groundskeeper exposure to groundwater is due entirely to the presence of low levels of ADNT (Table 7). The total HI summed across media of $1.81\text{E}-1$ falls below the threshold level of 1.

Total Soil and Groundwater: The ILCR of $7.36\text{E}-5$ for groundskeeper exposure to total soil is due entirely to arsenic (Table 4). The ILCR of $1.63\text{E}-5$ for groundskeeper exposure to groundwater (Table 7) was described above. The total ILCR summed across media of $8.99\text{E}-5$ falls within the risk management range.

The HI of $3.65\text{E}+0$ for groundskeeper exposure to total soil is due to antimony (HI = $3.27\text{E}+0$) and arsenic (HI = $3.82\text{E}-1$) (Table 4). The HI of $1.81\text{E}-1$ for groundskeeper exposure to groundwater (Table 7) was described above. The total HI summed across media of $3.83\text{E}+0$ exceeds the threshold level of 1. Antimony in total soil is the risk driver, and arsenic in total soil also contributes significantly to the unacceptable HI. Antimony, however, was identified in only 3 of 42 samples, with 1330 mg/kg as the MDC. The arithmetic mean concentration and the UCL on the arithmetic mean are 37.4 and 178 mg/kg, respectively (data not shown). Arsenic was identified in all 42 samples, with values for MDC, arithmetic mean and UCL on the arithmetic mean of 117, 10.7 and 22.5 mg/kg, respectively (data not shown).

The HI value for groundskeeper exposure to total soil can be refined by choosing the UCL on the mean rather than the MDC as the EPC. Refined HI values for groundskeeper exposure to

antimony and arsenic estimated in this manner are 4.37E-1 and 7.35E-2, respectively (data not shown). The refined total HI for groundskeeper exposure to total soil is 5.11E-1, and the refined total HI for groundskeeper exposure to total soil and groundwater is 6.92E-1, which falls below the threshold level of 1.

Lead was identified as a COPC in total soil because the MDC of 2.22E+4 mg/kg exceeds the groundskeeper SSSL (Table 4). A groundskeeper, however, would be exposed randomly across the entire site, such that the arithmetic mean concentration is a more reasonable EPC for lead. The arithmetic mean concentration of lead in total soil of 642 mg/kg (data not shown) falls below the groundskeeper SSSL. Lead in total soil is unlikely to induce adverse effects in children of a groundskeeper.

Construction Worker. The construction worker is evaluated for simultaneous exposure to total soil and groundwater. The construction worker scenario is generally considered the most conservative for short-term exposure to a site.

Total Soil and Groundwater: The ILCR of 5.90E-6 for construction worker exposure to total soil is due entirely to arsenic (Table 5). An ILCR for construction worker exposure to groundwater was not calculated because no chemicals in groundwater were selected as COPCs based on cancer risk (Table 8). The total ILCR summed across media of 5.90E-6 falls within the risk management range.

The HI of 7.44E+0 for construction worker exposure to total soil is due to antimony (HI = 6.68E+0) and arsenic (HI = 7.65E-1) (Table 5). The HI of 1.81E-1 for construction worker exposure to groundwater (Table 8) is identical to that for the groundskeeper described above. The total HI summed across media of 7.62E+0 exceeds the threshold level of 1. Antimony and arsenic in total soil are the major contributors as described for the groundskeeper. The HI values for these metals can be refined by using the UCL as the EPC as was done for the groundskeeper. Refined HI values for construction worker exposure to antimony and arsenic estimated in this manner are 8.94E-1 and 1.47E-1, respectively (data not shown). The refined total HI for groundskeeper exposure to total soil is 1.04E+0, and the refined total HI for groundskeeper exposure to total soil and groundwater is 1.22E+0, which rounded to one significant figure is equivalent to but does not exceed the threshold level of 1.

Lead was identified as a COPC in total soil because the MDC of 2.22E+4 mg/kg exceeds the construction worker SSSL (Table 5). However, the arithmetic mean concentration of lead in total soil of 642 mg/kg (data not shown) falls below the construction worker SSSL. Lead in total soil is unlikely to induce adverse effects in children of a construction worker.

Summary and Conclusions. In summary, surface soil, total soil and groundwater at the Impact Area were evaluated for risk under three separate receptor exposure scenarios. The Impact Area is slated for development for industrial purposes. Therefore, the groundskeeper scenario was evaluated as the upper bound on risk for long-term industrial exposure, and the construction worker scenario was evaluated as the upper bound on risk for short-term exposure. Although residential site use is precluded by industrial development, the residential scenario was included

for the additional information and perspective provided. Also, should the site pass the residential evaluation, it could be released for unrestricted use with no further action.

The Impact Area has clearly been affected by bullets and bullet fragments. Site-related chemicals in soil include metals associated with bullets, including antimony, arsenic, copper, and lead. Concentrations (except copper) are higher in subsurface soil than surface soil, suggesting that bullet penetration of the surface probably occurred. Other site-related chemicals in soil include a few detections of low levels of several VOCs, two hits of a chlorinated herbicide, and a single detection of a low level of DDT.

Site-related chemicals in groundwater include low levels of many organochlorine pesticides and two nitroaromatic compounds. Notably, metals associated with bullets were not detected in groundwater. The source(s) of the pesticides and nitroaromatic compounds is unclear, because none of the organic compounds identified in groundwater were detected in soil. Also, none of the VOCs identified in soil were detected in groundwater. It is noteworthy that groundwater concentrations do not exceed maximum contaminant levels (MCL) (EPA, 2002c) for the few site-related chemicals (five pesticides) for which MCLs are available.

The residential risk evaluation failed primarily because of the concentrations of lead in total soil, but with significant contributions from antimony and arsenic as well (Table 3). Both the groundskeeper and construction worker risk evaluations passed when the MDC was replaced with a more reasonable conservative estimate of average as the EPC. It is concluded that the Impact Area may be released for industrial use, but not for residential use, with no further action.

Lead is clearly the most abundant site-related contaminant present on the Impact Area. Evaluation of the surface soil data (Table 5-1 of the SI report) permits identification of three discrete zones of contamination, and isopleths of lead concentration were identified within each zone (Figure 5-1 of the SI report). Surface soil concentrations of lead outside the three discrete zones did not exceed the BSC.

Subsurface soil contamination appears to be considerably less widespread. Only four of 20 subsurface soil samples contained lead at levels above the BSC. Hand plotting the subsurface soil lead concentrations (data not shown) did not reveal a discernable pattern of distribution. For example, only one subsurface soil sample in the northeastern-most contamination zone (41 mg/kg) very slightly exceeded the BSC (40.05 mg/kg). No subsurface soil lead concentrations in the middle contamination zones exceeded the BSC. Only one subsurface soil sample in the southwestern-most contamination zone exceeded the BSC. Subsurface soil at sample location IMP-IASPOW-GP03 at the 3- to 4-ft bgs level (Sample Number QG0006) contained 22,200 mg/kg (equivalent to 2.2 percent). At the same sample location, lead concentration at the surface was only 110 mg/kg, and lead at 4 to 6 ft bgs was well within background levels. One subsurface sample far outside the three distinct contamination zones (sample location IMP-IASPOW-GP02, at the southwestern border of the Impact Area) contained lead at 429 mg/kg.

Examination of the raw data (Tables 5-1 and 5-2 and Figure 5-1 of the SI report) revealed that the highest concentrations of lead, antimony and arsenic all occurred in Sample Number QG0006. The extraordinarily high levels of metals associated with this single sample prompted

speculation that the residential exposure scenario might pass the risk evaluation if the soil associated with this sample were removed. This speculation was pursued by eliminating Sample Number QG0006 from the metals data sets and recalculating EPCs based on UCLs. The recalculated UCLs were then used to refine the risk and hazard estimates for residential exposure to total soil. The recalculated UCLs for antimony and arsenic are 6.02 and 10.2 mg/kg, respectively (data not shown). The refined ILCR for residential exposure to arsenic in total soil is 2.39E-5, and the refined HI values for antimony and arsenic are 1.94E-1 and 4.36E-1, respectively. The total ILCR summed across total soil and groundwater of 9.16E-5 falls within the risk management range. The total HI summed across total soil and groundwater of 2.37 exceeds the threshold level of 1.

The HI of 2.37 was segregated by target organ as a final step to refining the noncancer risk evaluation for the resident:

Chemical	Target Organs ^a				
	Heart	Skin	PVS	Liver	RBC
Contribution to Total HI from Chemicals in Total Soil					
Antimony	1.94E-1				
Arsenic		4.36E-1	4.36E-1		
Contribution to Total HI from Chemicals in Groundwater (Table 6)					
Aldrin				1.71E-1	
Dieldrin				2.14E-1	
Heptachlor epoxide				1.83E-1	
4-Amino-2,6-dinitrotoluene (ADNT)				1.18E+0	1.18E+0
Total Target Organ HI	1.94E-1	4.36E-1	4.36E-1	1.75E+0	1.18E+0
a Please see Toxicological Profiles in Appendix A of the following reference for target organs: IT Corporation (IT), 2000, <i>Human Health and Ecological Screening Values and PAH Background Summary Report</i> , Final, Fort McClellan, Calhoun County, Alabama, Prepared for U.S. Army Corps of Engineers, Mobile District, August. PVS = peripheral vascular system; RBC = red blood cell or erythrocyte.					

The total HI for all target organs falls below the threshold level of 1 except for the liver and erythrocyte. However, when the HI is rounded to one significant figure, the HI for the erythrocyte does not exceed the threshold level of 1.

The HI for the liver exceeds the threshold level of 1 due to the contributions from two classes of chemicals. Aldrin, dieldrin and heptachlor epoxide belong to the class of chemicals known as organochlorine pesticides. These compounds act upon the liver by a common mechanism of toxicity involving induction of certain liver enzymes in the mixed function oxidase group, which results in altered steroid metabolism and a hepatocytic preneoplastic or proliferative response (ATSDR, 1993, 2002). Essentially nothing is known about the mechanism of toxicity of ADNT; however, the mechanism of toxicity of its parent compound, 1,4,6-trinitrotoluene (TNT), is understood. TNT undergoes degradation and reduction to release hydroxylamine groups that bind to sulfhydryl proteins and induce free radical formation within the hepatocellular mitochondria and microsomes (ATSDR, 1995). These changes cause hepatocellular damage and necrosis, interfering with normal liver function. It is assumed that the mechanisms of toxicity of ADNT and TNT are the same.

The preceding discussion is sufficient to conclude that the mechanisms of toxicity of the organochlorine pesticides and ADNT are different. Therefore, HI values estimated for the organochlorine pesticides should not be summed with the HI for ADNT. The total HI for the organochlorine pesticides of 5.68E-1 falls below the threshold value of 1. The HI for ADNT of 1.18E+0 when rounded to one significant figure does not exceed the threshold value of 1.

Removal of Sample Number QG0006 from the total soil data set results in a new MDC for lead of 809 mg/kg and a new arithmetic mean concentration of 116 mg/kg (data not shown). Lead was selected as a COPC for residential exposure because the MDC exceeds the SSSL of 400 mg/kg. However, the arithmetic mean lead concentration falls below the SSSL. Furthermore, the MDC falls below the EPA (2003) acute criterion for lead in soil of 6,500 mg/kg.

It is concluded that the Impact Area can be released in its present condition for industrial use, but not for residential or unrestricted use, with no further action. It is also concluded that the Impact Area could be released for unrestricted use if all soil associated with Sample Number QG0006 (IMP-IASPOW-GP03) were removed or otherwise treated to reduce or preclude exposure to antimony, arsenic and lead. *The conclusions stated here are subject to the risk managers consideration of the uncertainty discussed below.*

A very significant source of uncertainty associated with this assessment is related to the observation recorded in the first paragraph, that expended bullets and bullet fragments were observed on the surface over a substantial portion of the site. Large metal fragments ordinarily are screened out during sampling and are not included for analysis, so the metals associated with these fragments were not included in the health assessment. It is known, however, that lead bullets and fragments oxidize and degrade slowly over time, releasing lead compounds to the soil (EPA, 2000, 2001, 2002b). At present, little is known regarding the rate and extent of this degradation, and the extent, if any, to which soil concentrations of lead, and possibly antimony and arsenic, may rise with time. It is possible, therefore, that health risks may increase with time unless the bullet fragments on the surface (or possibly buried beneath the surface) are removed or otherwise rendered inert to further degradation. Furthermore, the bullets and larger fragments visible on the surface may be attractive to a child that practices pica, representing a type of risk not evaluated herein. *This source of uncertainty must be brought to the attention of the site managers.*

Another less significant source of uncertainty pertains to the groundwater. The groundwater data set is limited to two sampling rounds from two wells. Both wells are located outside of the three discrete contaminated areas, and may not have captured the full potential for leaching of metals associated with bullets. However, the metals identified in groundwater appear to be present at concentrations comparable to background. Of particular interest was the observation of low levels of a wide variety of organochlorine pesticides in both wells. None of the organochlorine pesticides detected in groundwater were detected in soil, although only three surface soil samples and three subsurface soil samples were analyzed for organochlorine pesticides. Their source in groundwater at the Impact Area is unclear. Similarly, two nitroaromatic compounds were detected in groundwater. Neither of the nitroaromatic compounds detected in groundwater were detected in soil. A total of 12 surface soil and 9 subsurface soil samples were analyzed for

nitroaromatic compounds. Nitroaromatic compounds as residue of gunpowder are more likely to be found nearer the firing line than the bullet impact area. The source of these compounds in groundwater at the Impact Area is unclear.

References

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Table 1

**Preliminary Risk Assessment for Residential Exposure to Surface Soil
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Residential Soil SSSL-c ^b	Residential Soil SSSL-n ^c	Residential Cancer COPC? ^d	Residential Noncancer COPC? ^e	Residential ILCR ^f	Residential HI ^g
Metals								
Aluminum	3.20E+04	No(3)	NA	7.80E+03				
Antimony	5.41E+00	No(2)	NA	3.11E+00		5.41E+00		1.74E-01
Arsenic	1.66E+01	No(3)	4.26E-01	2.34E+00				
Barium	1.24E+02	No(3)	NA	5.47E+02				
Beryllium	1.57E+00	No(3)	NA	9.60E+00				
Calcium	1.39E+03	No(E)	NA	NA				
Chromium ^h	3.77E+01	No(3)	NA	2.32E+01				
Cobalt	2.34E+01	No(3)	NA	4.68E+02				
Copper	2.00E+02	2.00E+02	NA	3.13E+02				
Iron	4.54E+04	No(3)	NA	2.34E+03				
Lead	8.09E+02	8.09E+02	NA	4.00E+02		8.09E+02		
Magnesium	1.42E+03	No(E)	NA	NA				
Manganese	3.19E+03	No(3)	NA	3.63E+02				
Mercury	1.12E-01	No(2)	NA	2.33E+00				
Nickel	1.82E+01	No(3)	NA	1.54E+02				
Potassium	1.11E+03	No(E)	NA	NA				
Selenium	2.08E+00	No(3)	NA	3.91E+01				
Silver	2.13E+00	No(3)	NA	3.91E+01				
Sodium	6.82E+01	No(E)	NA	NA				
Vanadium	5.29E+01	No(1)	NA	5.31E+01				
Zinc	5.54E+01	No(3)	NA	2.34E+03				
Pesticides								
4,4'-DDT	8.90E-04	8.90E-04	1.79E+00	3.83E+00				
Volatile Organic Compounds								
2-Butanone	1.80E-02	1.80E-02	NA	4.66E+03				
Acetone	3.30E-01	3.30E-01	NA	7.76E+02				
Tetrachloroethene	1.20E-03	1.20E-03	1.21E+01	7.77E+01				
Trichloroethene	1.90E-03	1.90E-03	5.72E+01	4.66E+01				
Trichlorofluoromethane	2.00E-03	2.00E-03	NA	2.33E+03				
Total ILCR, HI							--	1.74E-01

All concentrations expressed as mg/kg.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index.

-- = Not Calculated

NA = Not Available

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

Table 1

**Preliminary Risk Assessment for Residential Exposure to Surface Soil
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for residential exposure to soil.

^c Site-specific screening level based on noncancer hazard for residential exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for resident exposed to chemical in soil.

^g Hazard index for noncancer effects for resident exposed to chemical in soil.

^h SSSL based on chromium VI.

Table 2

**Preliminary Risk Assessment for the Groundskeeper Exposure to Surface Soil
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site- Related Chemical? ^a	Groundskeeper Soil SSSL-c ^b	Groundskeeper Soil SSSL-n ^c	Groundskeeper Cancer COPC? ^d	Groundskeeper Noncancer COPC? ^e	Groundskeeper ILCR ^f	Groundskeeper HI ^g
Metals								
Aluminum	3.20E+04	No(3)	NA	6.69E+03				
Antimony	5.41E+00	No(2)	NA	4.07E+01				
Arsenic	1.66E+01	No(3)	1.59E+00	3.06E+01				
Barium	1.24E+02	No(3)	NA	6.50E+02				
Beryllium	1.57E+00	No(3)	1.70E+01	2.39E+01				
Calcium	1.39E+03	No(E)	NA	NA				
Chromium ^h	3.77E+01	No(3)	3.41E+00	9.96E+01				
Cobalt	2.34E+01	No(3)	NA	2.90E+01				
Copper	2.00E+02	2.00E+02	NA	4.08E+03				
Iron	4.54E+04	No(3)	NA	3.06E+04				
Lead	8.09E+02	8.09E+02	NA	8.80E+02				
Magnesium	1.42E+03	No(E)	NA	NA				
Manganese	3.19E+03	No(3)	NA	7.05E+01				
Mercury	1.12E-01	No(2)	NA	2.85E+01				
Nickel	1.82E+01	No(3)	1.70E+02	2.02E+03				
Potassium	1.11E+03	No(E)	NA	NA				
Selenium	2.08E+00	No(3)	NA	5.11E+02				
Silver	2.13E+00	No(3)	NA	5.11E+02				
Sodium	6.82E+01	No(E)	NA	NA				
Vanadium	5.29E+01	No(1)	NA	6.97E+02				
Zinc	5.54E+01	No(3)	NA	3.06E+04				
Pesticides								
4,4'-DDT	8.90E-04	8.90E-04	8.11E+00	5.02E+01				
Volatile Organic Compounds								
2-Butanone	1.80E-02	1.80E-02	NA	5.86E+04				
Acetone	3.30E-01	3.30E-01	NA	1.02E+04				
Tetrachloroethene	1.20E-03	1.20E-03	5.47E+01	1.02E+03				
Trichloroethene	1.90E-03	1.90E-03	2.56E+02	6.10E+02				
Trichlorofluoromethane	2.00E-03	2.00E-03	NA	2.96E+04				
Total ILCR, HI							--	--

All concentrations expressed as mg/kg.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index.

-- = Not Calculated

NA = Not Available

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

Table 2

**Preliminary Risk Assessment for the Groundskeeper Exposure to Surface Soil
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

- No(1) = Deselected as a site-related chemical at Tier 1.
No(2) = Deselected as a site-related chemical at Tier 2.
No(3) = Deselected as a site-related chemical at Tier 3.
- ^b Site-specific screening level based on cancer risk for groundskeeper exposure to soil.
^c Site-specific screening level based on noncancer hazard for groundskeeper exposure to soil.
^d MDC presented only if it exceeds SSSL-c.
^e MDC presented only if it exceeds SSSL-n.
^f Incremental lifetime cancer risk for groundskeeper exposed to chemical in soil.
^g Hazard index for noncancer effects for groundskeeper exposed to chemical in soil.
^h SSSL based on chromium VI.

Table 3

**Preliminary Risk Assessment for Residential Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Residential Soil SSSL-c ^b	Residential Soil SSSL-n ^c	Residential Cancer COPC? ^d	Residential Noncancer COPC? ^e	Residential ILCR ^f	Residential HI ^g
Metals								
Aluminum	3.20E+04	No(3)	NA	7.80E+03				
Antimony	1.33E+03	1.33E+03	NA	3.11E+00		1.33E+03		4.28E+01
Arsenic	1.17E+02	1.17E+02	4.26E-01	2.34E+00	1.17E+02	1.17E+02	2.75E-04	4.99E+00
Barium	1.24E+02	No(1)	NA	5.47E+02				
Beryllium	1.57E+00	No(3)	NA	9.60E+00				
Calcium	1.39E+03	No(E)	NA	NA				
Chromium ^h	7.18E+01	No(3)	NA	2.32E+01				
Cobalt	2.34E+01	No(3)	NA	4.68E+02				
Copper	2.00E+02	2.00E+02	NA	3.13E+02				
Iron	4.54E+04	No(3)	NA	2.34E+03				
Lead	2.22E+04	2.22E+04	NA	4.00E+02		2.22E+04		
Magnesium	1.42E+03	No(E)	NA	NA				
Manganese	3.19E+03	No(3)	NA	3.63E+02				
Mercury	1.57E-01	No(3)	NA	2.33E+00				
Nickel	1.82E+01	No(3)	NA	1.54E+02				
Potassium	1.50E+03	No(E)	NA	NA				
Selenium	2.08E+00	No(3)	NA	3.91E+01				
Silver	3.01E+00	No(3)	NA	3.91E+01				
Sodium	6.82E+01	No(E)	NA	NA				
Vanadium	5.97E+01	No(1)	NA	5.31E+01				
Zinc	5.54E+01	No(3)	NA	2.34E+03				
Pesticides								
4,4'-DDT	8.90E-04	8.90E-04	1.79E+00	3.83E+00				
Herbicides								
MCPP	7.40E-01	7.40E-01	NA	7.77E+00				
Volatile Organic Compounds								
2-Butanone	2.20E-02	2.20E-02	NA	4.66E+03				
Acetone	3.30E-01	3.30E-01	NA	7.76E+02				
Tetrachloroethene	1.20E-03	1.20E-03	1.21E+01	7.77E+01				
Trichloroethene	1.90E-03	1.90E-03	5.72E+01	4.66E+01				
Trichlorofluoromethane	2.00E-03	2.00E-03	NA	2.33E+03				
Total ILCR, HI							2.75E-04	4.78E+01

All concentrations expressed as mg/kg.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index.

-- = Not Calculated

NA = Not Available

Table 3

**Preliminary Risk Assessment for Residential Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for residential exposure to soil.

^c Site-specific screening level based on noncancer hazard for residential exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for resident exposed to chemical in soil.

^g Hazard index for noncancer effects for resident exposed to chemical in soil.

^h SSSL based on chromium VI.

Table 4

**Preliminary Risk Assessment for the Groundskeeper Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcel 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Groundskeeper Soil SSSL-c ^b	Groundskeeper Soil SSSL-n ^c	Groundskeeper Cancer COPC? ^d	Groundskeeper Noncancer COPC? ^e	Groundskeeper ILCR ^f	Groundskeeper HI ^g
Metals								
Aluminum	3.20E+04	No(3)	NA	6.69E+03				
Antimony	1.33E+03	1.33E+03	NA	4.07E+01		1.33E+03		3.27E+00
Arsenic	1.17E+02	1.17E+02	1.59E+00	3.06E+01	1.17E+02	1.17E+02	7.36E-05	3.82E-01
Barium	1.24E+02	No(1)	NA	6.50E+02				
Beryllium	1.57E+00	No(3)	1.70E+01	2.39E+01				
Calcium	1.39E+03	No(E)	NA	NA				
Chromium ^h	7.18E+01	No(3)	3.41E+00	9.96E+01				
Cobalt	2.34E+01	No(3)	NA	2.90E+01				
Copper	2.00E+02	2.00E+02	NA	4.08E+03				
Iron	4.54E+04	No(3)	NA	3.06E+04				
Lead	2.22E+04	2.22E+04	NA	8.80E+02		2.22E+04		
Magnesium	1.42E+03	No(E)	NA	NA				
Manganese	3.19E+03	No(3)	NA	7.05E+01				
Mercury	1.57E-01	No(3)	NA	2.85E+01				
Nickel	1.82E+01	No(3)	1.70E+02	2.02E+03				
Potassium	1.50E+03	No(E)	NA	NA				
Selenium	2.08E+00	No(3)	NA	5.11E+02				
Silver	3.01E+00	No(3)	NA	5.11E+02				
Sodium	6.82E+01	No(E)	NA	NA				
Vanadium	5.97E+01	No(1)	NA	6.97E+02				
Zinc	5.54E+01	No(3)	NA	3.06E+04				
Pesticides								
4,4'-DDT	8.90E-04	8.90E-04	8.11E+00	5.02E+01				
Herbicides								
MCPP	7.40E-01	7.40E-01	NA	1.02E+02				
Volatile Organic Compounds								
2-Butanone	2.20E-02	2.20E-02	NA	5.86E+04				
Acetone	3.30E-01	3.30E-01	NA	1.02E+04				
Tetrachloroethene	1.20E-03	1.20E-03	5.47E+01	1.02E+03				
Trichloroethene	1.90E-03	1.90E-03	2.56E+02	6.10E+02				
Trichlorofluoromethane	2.00E-03	2.00E-03	NA	2.96E+04				
Total ILCR, HI							7.36E-05	3.65E+00

All concentrations expressed as mg/kg.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index.

-- = Not Calculated

NA = Not Available

Table 4

**Preliminary Risk Assessment for the Groundskeeper Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcel 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Groundskeeper Soil SSSL-c ^b	Groundskeeper Soil SSSL-n ^c	Groundskeeper Cancer COPC? ^d	Groundskeeper Noncancer COPC? ^e	Groundskeeper ILCR ^f	Groundskeeper HI ^g
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^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for groundskeeper exposure to soil.

^c Site-specific screening level based on noncancer hazard for groundskeeper exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for groundskeeper exposed to chemical in soil.

^g Hazard index for noncancer effects for groundskeeper exposed to chemical in soil.

^h SSSL based on chromium VI.

Table 5

**Preliminary Risk Assessment for the Construction Worker Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Construction Worker Soil SSSL-c ^b	Construction Worker Soil SSSL-n ^c	Construction Worker Cancer COPC? ^d	Construction Worker Noncancer COPC? ^e	Construction Worker ILCR ^f	Construction Worker HI ^g
Metals								
Aluminum	3.20E+04	No(3)	NA	3.34E+03				
Antimony	1.33E+03	1.33E+03	NA	1.99E+01		1.33E+03		6.68E+00
Arsenic	1.17E+02	1.17E+02	1.98E+01	1.53E+01	1.17E+02	1.17E+02	5.90E-06	7.65E-01
Barium	1.24E+02	No(1)	NA	3.25E+02				
Beryllium	1.57E+00	No(3)	2.13E+02	9.60E+00				
Calcium	1.39E+03	No(E)	NA	NA				
Chromium ^h	7.18E+01	No(3)	4.26E+01	4.91E+01				
Cobalt	2.34E+01	No(3)	NA	1.45E+01				
Copper	2.00E+02	2.00E+02	NA	2.04E+03				
Iron	4.54E+04	No(3)	NA	1.53E+04				
Lead	2.22E+04	2.22E+04	NA	8.80E+02		2.22E+04		
Magnesium	1.42E+03	No(E)	NA	NA				
Manganese	3.19E+03	No(3)	NA	3.52E+01				
Mercury	1.57E-01	No(3)	NA	1.38E+01				
Nickel	1.82E+01	No(3)	2.13E+03	9.59E+02				
Potassium	1.50E+03	No(E)	NA	NA				
Selenium	2.08E+00	No(3)	NA	2.55E+02				
Silver	3.01E+00	No(3)	NA	2.56E+02				
Sodium	6.82E+01	No(E)	NA	NA				
Vanadium	5.97E+01	No(1)	NA	3.16E+02				
Zinc	5.54E+01	No(3)	NA	1.52E+04				
Pesticides								
4,4'-DDT	8.90E-04	8.90E-04	9.50E+01	2.35E+01				
Herbicides								
MCPP	7.40E-01	7.40E-01	NA	4.97E+01				
Volatile Organic Compounds								
2-Butanone	2.20E-02	2.20E-02	NA	2.86E+04				
Acetone	3.30E-01	3.30E-01	NA	4.95E+03				
Tetrachloroethene	1.20E-03	1.20E-03	6.70E+02	4.97E+02				
Trichloroethene	1.90E-03	1.90E-03	3.13E+03	2.98E+02				
Trichlorofluoromethane	2.00E-03	2.00E-03	NA	1.44E+04				
Total ILCR, HI							5.90E-06	7.44E+00

All concentrations expressed as mg/kg.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index.

-- = Not Calculated

NA = Not Available

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

Table 5

**Preliminary Risk Assessment for the Construction Worker Exposure to Total Soil (Surface and Subsurface Combined)
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Construction Worker Soil SSSL-c ^b	Construction Worker Soil SSSL-n ^c	Construction Worker Cancer COPC? ^d	Construction Worker Noncancer COPC? ^e	Construction Worker ILCR ^f	Construction Worker HI ^g
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No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for construction worker exposure to soil.

^c Site-specific screening level based on noncancer hazard for construction worker exposure to soil.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for construction worker exposed to chemical in soil.

^g Hazard index for noncancer effects for construction worker exposed to chemical in soil.

^h SSSL based on chromium VI.

Table 6

**Preliminary Risk Assessment for Residential Exposure to Groundwater
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Residential Groundwater SSSL-c ^b	Residential Groundwater SSSL-n ^c	Residential Cancer COPC? ^d	Residential Noncancer COPC? ^e	Residential ILCR ^f	Residential HI ^g	MCL ^h
Metals									
Aluminum	3.16E-01	No(1)	NA	1.56E+00					
Barium	1.55E-02	No(1)	NA	1.10E-01					
Cobalt	1.53E-02	No(1)	NA	9.39E-02					
Iron	6.73E-01	No(1)	NA	4.69E-01					
Manganese	6.37E-01	No(2)	NA	7.35E-02					
Pesticides									
4,4'-DDD	1.60E-04	1.60E-04	1.83E-04	NA					
Aldrin	8.00E-05	8.00E-05	3.92E-06	4.67E-05	8.00E-05	8.00E-05	2.04E-05	1.71E-01	
Dieldrin	1.60E-04	1.60E-04	3.97E-06	7.47E-05	1.60E-04	1.60E-04	4.03E-05	2.14E-01	
Endosulfan I	3.90E-05	3.90E-05	NA	9.35E-03					
Endosulfan II	2.50E-05	2.50E-05	NA	9.35E-03					
Endrin	2.20E-04	2.20E-04	NA	4.48E-04					2.00E-03
Heptachlor epoxide	3.40E-05	3.40E-05	6.63E-06	1.85E-05	3.40E-05	3.40E-05	5.13E-06	1.83E-01	2.00E-04
alpha-Chlordane	1.50E-04	1.50E-04	1.75E-04	7.22E-04					2.00E-03
beta-BHC	6.90E-05	6.90E-05	3.61E-05	NA	6.90E-05		1.91E-06		
delta-BHC	3.00E-05	3.00E-05	NA	4.49E-04					
gamma-BHC (Lindane)	3.80E-05	3.80E-05	5.03E-05	4.60E-04					2.00E-04
gamma-Chlordane	8.10E-05	8.10E-05	1.75E-04	7.22E-04					2.00E-03
Nitroaromatics									
2-Nitrotoluene	2.10E-03	2.10E-03	NA	1.53E-02					
4-Amino-2,6-dinitrotoluene	1.10E-03	1.10E-03	NA	9.36E-05		1.10E-03		1.18E+00	
Total ILCR, HI							6.77E-05	1.74E+00	

All concentrations expressed as mg/L.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index; MCL = maximum contaminant level (presented only for site-related chemicals); NA = Not available.

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for residential exposure to groundwater.

^c Site-specific screening level based on noncancer hazard for residential exposure to groundwater.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for resident exposed to chemical in groundwater.

^g Hazard index for noncancer effects for resident exposed to chemical in groundwater.

^h EPA, 2002, 2002 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Washington, DC, EPA 822-R-02-038, Summer.

Table 7

**Preliminary Risk Assessment for Groundskeeper Exposure to Groundwater
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Groundskeeper Groundwater SSSL-c ^b	Groundskeeper Groundwater SSSL-n ^c	Groundskeeper Cancer COPC? ^d	Groundskeeper Noncancer COPC? ^e	Groundskeeper ILCR ^f	Groundskeeper HI ^g	MCL ^h
Metals									
Aluminum	3.16E-01	No(1)	NA	1.01E+01					
Barium	1.55E-02	No(1)	NA	7.12E-01					
Cobalt	1.53E-02	No(1)	NA	6.08E-01					
Iron	6.73E-01	No(1)	NA	3.05E+00					
Manganese	6.37E-01	No(2)	NA	4.44E-01					
Pesticides									
4,4'-DDD	1.60E-04	1.60E-04	5.24E-04	NA					
Aldrin	8.00E-05	8.00E-05	1.66E-05	3.03E-04	8.00E-05		4.81E-06		
Dieldrin	1.60E-04	1.60E-04	1.58E-05	4.52E-04	1.60E-04		1.01E-05		
Endosulfan I	3.90E-05	3.90E-05	NA	6.07E-02					
Endosulfan II	2.50E-05	2.50E-05	NA	6.07E-02					
Endrin	2.20E-04	2.20E-04	NA	2.71E-03					2.00E-03
Heptachlor epoxide	3.40E-05	3.40E-05	2.47E-05	1.05E-04	3.40E-05		1.37E-06		2.00E-04
alpha-Chlordane	1.50E-04	1.50E-04	6.62E-04	4.14E-03					2.00E-03
beta-BHC	6.90E-05	6.90E-05	1.48E-04	NA					
delta-BHC	3.00E-05	3.00E-05	NA	2.73E-03					
gamma-BHC (Lindane)	3.80E-05	3.80E-05	2.08E-04	2.90E-03					2.00E-04
gamma-Chlordane	8.10E-05	8.10E-05	6.62E-04	4.14E-03					2.00E-03
Nitroaromatics									
2-Nitrotoluene	2.10E-03	2.10E-03	NA	9.69E-02					
4-Amino-2,6-dinitrotoluene	1.10E-03	1.10E-03	NA	6.09E-04		1.10E-03		1.81E-01	
Total ILCR, HI							1.63E-05	1.81E-01	

All concentrations expressed as mg/L.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index; MCL = maximum contaminant level (presented only for site-related chemicals); NA = Not available.

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for residential exposure to groundwater.

^c Site-specific screening level based on noncancer hazard for residential exposure to groundwater.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for resident exposed to chemical in groundwater.

^g Hazard index for noncancer effects for resident exposed to chemical in groundwater.

^h EPA, 2002, 2002 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Washington, DC, EPA 822-R-02-038, Summer.

Table 8

**Preliminary Risk Assessment for the Construction Worker Exposure to Groundwater
Impact Area South of POW Training Facility, Parcels 100(Q) and 101(Q)
Fort McClellan, Calhoun County, Alabama**

Chemical	MDC	Site-Related Chemical? ^a	Construction Worker Groundwater SSSL-c ^a	Construction Worker Groundwater SSSL-n ^b	Construction Worker Cancer COPC? ^d	Construction Worker Noncancer COPC? ^e	Construction Worker ILCR ^f	Construction Worker HI ^g	MCL ^h
Metals									
Aluminum	3.16E-01	No(1)	NA	1.01E+01					
Barium	1.55E-02	No(1)	NA	7.12E-01					
Cobalt	1.53E-02	No(1)	NA	6.08E-01					
Iron	6.73E-01	No(1)	NA	3.05E+00					
Manganese	6.37E-01	No(2)	NA	4.44E-01					
Pesticides									
4,4'-DDD	1.60E-04	1.60E-04	1.31E-02	NA					
Aldrin	8.00E-05	8.00E-05	4.15E-04	3.03E-04					
Dieldrin	1.60E-04	1.60E-04	3.95E-04	4.52E-04					
Endosulfan I	3.90E-05	3.90E-05	NA	6.07E-02					
Endosulfan II	2.50E-05	2.50E-05	NA	6.07E-02					
Endrin	2.20E-04	2.20E-04	NA	2.71E-03					2.00E-03
Heptachlor epoxide	3.40E-05	3.40E-05	6.19E-04	1.05E-04					2.00E-04
alpha-Chlordane	1.50E-04	1.50E-04	1.65E-02	4.14E-03					2.00E-03
beta-BHC	6.90E-05	6.90E-05	3.69E-03	NA					
delta-BHC	3.00E-05	3.00E-05	NA	2.73E-03					
gamma-BHC (Lindane)	3.80E-05	3.80E-05	5.20E-03	2.90E-03					2.00E-04
gamma-Chlordane	8.10E-05	8.10E-05	1.65E-02	4.14E-03					2.00E-03
Nitroaromatics									
2-Nitrotoluene	2.10E-03	2.10E-03	NA	9.69E-02					
4-Amino-2,6-dinitrotoluene	1.10E-03	1.10E-03	NA	6.09E-04		1.10E-03		1.81E-01	
Total ILCR, HI							--	1.81E-01	

All concentrations expressed as mg/L.

MDC = Maximum Detected Concentration; COPC = Chemical of Potential Concern; ILCR = Incremental Lifetime Cancer Risk; HI = Hazard Index; MCL = maximum contaminant level (presented only for site-related chemicals); NA = Not available.

^a MDC presented only for site-related chemicals.

No(E) = Deselected as a site-related chemical as a nutritionally required element.

No(1) = Deselected as a site-related chemical at Tier 1.

No(2) = Deselected as a site-related chemical at Tier 2.

No(3) = Deselected as a site-related chemical at Tier 3.

^b Site-specific screening level based on cancer risk for residential exposure to groundwater.

^c Site-specific screening level based on noncancer hazard for residential exposure to groundwater.

^d MDC presented only if it exceeds SSSL-c.

^e MDC presented only if it exceeds SSSL-n.

^f Incremental lifetime cancer risk for resident exposed to chemical in groundwater.

^g Hazard index for noncancer effects for resident exposed to chemical in groundwater.

^h EPA, 2002, 2002 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Washington, DC, EPA 822-R-02-038, Summer.